H4 Evaluation of Five Dental Calcification Formulas for Estimating Age in South Africans

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After attending this presentation, attendees will gain knowledge of the reliability and validity of five dental calcification correction factor formulas that are currently used to estimate age among South Africans.

This presentation will impact the forensic science community by providing information on the applicability of dental calcification correction factor formulas on South Africans and evaluating the reliability for scoring dental calcification.

Demirjian is a popular age-at-death method that examines calcification of seven teeth (I1 – M2) in the mandibular quadrant of 20th-century Canadian children.[1] The methodology is based on a dental maturity score which is derived from both the observed tooth stages and the corresponding weights assigned to each tooth. Using the provided percentiles, the maturity score is transformed into an age estimate. Despite some disadvantages, this method is often preferred to Moorrees which examines calcification per individual tooth rather than per quadrant.[2]

In two validation studies on South African children, the Demirjian formula has been shown to be consistently inaccurate.[1] In order to improve both accuracy and applicability, Phillips and Uys established South African correction factors based on the Demirjian methodology.[1,3,4] While these correction factor formula are currently used in South Africa, they have not been tested for either reliability or validity. The purpose of this study is to test both the reliability of the dental calcification method and the accuracy of the correction factor formula on an independent sample of South African children.

Three hundred and sixty-three panoramic and radiographs (164 males; 199 females) of black, white, and colored groups aged 6 to 10 years were collected both from private dental practices in Pretoria, South Africa, and from the Red Cross War Memorial Children's Hospital in Cape Town, South Africa. Each mandible in the radiograph was scored according to the Demirjian methodology.[1] The Uys (UFBM and UFBF) and Phillips (P.Indian, P.Black, Tygerburg) correction factors were used to provide an age estimation. The Uys correction factors separated into sex groups but not ancestry, whereas the Phillips correction separated into ancestry but not sex.[3,4] Therefore, a total of five different age estimations inclusive or exclusive of either sex or ancestry were compared to true age in all cases.

Statistical analyses included error margin and bias to validate the technique and Analysis of Covariance (ANOVA) to explore differences between males and females. Error margin evaluated differences between estimated and true ages and bias examined whether the estimations were consistently over- or underestimating. For inter- and intra-observer error, ten images were randomly selected and scored by three observers of varying experience.

P.black had the smallest mean bias, mean error margin, and error margin range (-.27 years, .88 years, .006 years – 4.33 years), while P.Indian had the highest mean bias (.84 years), and UFBM had the highest mean error margin (1.1 years). No statistically significant sex differences in error margin or bias were noted for any of the five correction factors (all p-values >0.05). Inter- and intra-observer agreement ranged between 33% – 88% and 73 – 100%, respectively. The most common disagreement was between stages C (crown complete), D (dentine formation), G (root apex open), and H (root complete, apex closed). Low agreement was found with incisor roots; most likely due to poor visibility of these structures in the radiographic images.

While all five tested correction factors may be useful for estimating age in children, applicability of the methods is problematic, especially without known sex or ancestry. While sex was shown to not affect age estimations, ancestry presented with far more variability. P.Black demonstrated the lowest error margin and bias, which suggests this may be the best correction factor to employ.

Though several correction factors have been derived for South Africans none of the equations are predictive. Upon thorough evaluation of the methodologies, it is clear that none of the outputs are presented in a usable fashion; formula should result in an age estimation with associated standard deviations. Although these researchers have collected population-specific data which should yield better results than Demirjian, the data is not presented in a usable format.[1]

References:

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Error Margin, Bias, Validation

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